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Cost-Effective Hedges and Accounting Standards

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SYNOPSIS: Using return data from other studies, we show that traditional short hedgers often face a cost in the form of a positive derivative risk premium. Consequently, the hedge ratio chosen should be significantly less than the traditional risk minimum hedge ratio since marginal cost rises dramatically as the risk minimum position is approached. We present a modified hedge ratio and hedge effectiveness measures to replace the commonly used risk minimum equivalents. The use of these alternative measures is permissible under SFAS No. 133 and IAS No. 39 and leads to improved hedging decisions.

INTRODUCTION

A key hedge issue in accounting for derivatives is determining whether a derivative provides a "highly effective" hedge. If a company can demonstrate this, then the changes in the value of the derivative can be matched with the underlying spot position.[1] This more accurately captures the company's situation since hedging is intended to reduce volatility associated with changing values for inventory, financial instruments, and other business exposures. By reducing such risk exposures, management is free to focus on the business at hand rather than being preoccupied with tangential risks.

The hedge effectiveness criteria put forward by the Financial Accounting Standards Board (FASB 1998, 1999, 2000a, 2000b, 2001) and in IAS No. 39 (IASB 2000) are very open-ended in that the hedger can specify the method by which hedge effectiveness is to be measured. Into this breach, various academics and advisory services have inserted their own interpretation. As a result, the most common recommendation is that the company should focus on risk minimization. Finnerty and Grant (2002) provide a comprehensive review of the risk minimization measures of hedge effectiveness. These include:

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[1] The two most important hedges identified in SFAS No. 133 are fair value and cash flow hedges. In the case of the fair value hedge, the derivative gains and losses are included in current earnings and are offset, to the extent that the hedge is effective, by an adjustment to the hedged item's carrying value. In the case of a cash flow hedge, the effective portion of the derivative change goes to other comprehensive income and is later reclassified into earnings in the period the hedged transaction affects earnings. Thus in both cases, the change in value of the derivative is matched with the hedged transaction in the period it affects earnings.

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1. Dollar offset: to be considered an effective hedge, the ratio of the change in the derivative's fair market value and the change in the value of the spot position being hedged should fall within the range of 80 percent to 125 percent.[2]
2. Regression: the hedge ratio is set equal to the slope coefficient from the regression of spot returns on derivative returns, which is the risk minimum hedge ratio first proposed by Ederington (1979); to be effective, the R^2 of the regression should exceed .81.[3]
3. Risk minimization: to be considered an effective hedge, the standard deviation of the hedged position must be no more than 44 percent of the spot standard deviation.[4]

None of these explicitly addresses the possibility of a positive risk premium on the derivative and thus a hedging cost. Our purpose is to put forward an improved method for determining the hedge ratio that more accurately reflects the realities of hedging. To be clear, we are not criticizing the accounting standards per se, but instead are addressing the recommendation that the hedging decision be based purely on risk minimization. Indeed, the accounting standards appear broad enough to allow companies to use the cost-effective model by allowing a company to hedge a portion of their spot position (SFAS No. 133, para 21). The cost-effective approach we present in this paper shows how the hedger can determine this optimal proportion.

Our hedge ratio includes not only risk, but also the cost of hedging. The cost of hedging is significant for many contracts and therefore should be included in the hedging decision. The most important element driving this cost is the risk premium on the derivative that reduces the expected return when the typical short hedging position is taken. Two situations in which the traditional risk-minimizing approach leads to the correct hedging decision are (1) when there is no cost to hedging (i.e., the derivative not does include a risk premium), or (2) when the derivative is a perfect match for the spot position. These are exceptions and not the rule for most hedgers. The latter situation is covered extensively in SFAS No. 133 and is referred to as no ''hedge ineffectiveness.''

We present evidence that the futures risk premium across nine categories of contracts averaged 600 basis points (bp) over the last 50 years. Our proposed cost-effective model considers the cost of hedging resulting from this risk premium and, as a consequence, companies should prefer a hedge ratio that is much smaller than the risk minimum hedge ratio. Ignoring this cost and applying the traditional risk minimum hedge ratio leads to the undesirable situation of over-hedging in which the company incurs additional costs with few if any benefits. We attempt to rectify this situation by showing that, in the face of a hedging cost, it may make sense for the company to partially hedge its spot position.

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[2] This measure was first proposed by Swad (1995). Several authors have pointed out the problems in implementing the dollar offset measure (Finnerty and Grant 2002) and the unwieldy statistical distribution (Cauchy) of this ratio statistic (Canabarro 1999). Both problems are the result of small spot changes in the ratio's denominator. Thus Finnerty and Grant (2002), among others, recommend that dollar offset not be used as a measure of hedge effectiveness.

[3] This criterion has become an industry standard, but is not specifically mentioned in SFAS No. 133. The actual source is not known but it may have been a regulatory speech much like that which launched the dollar offset approach.

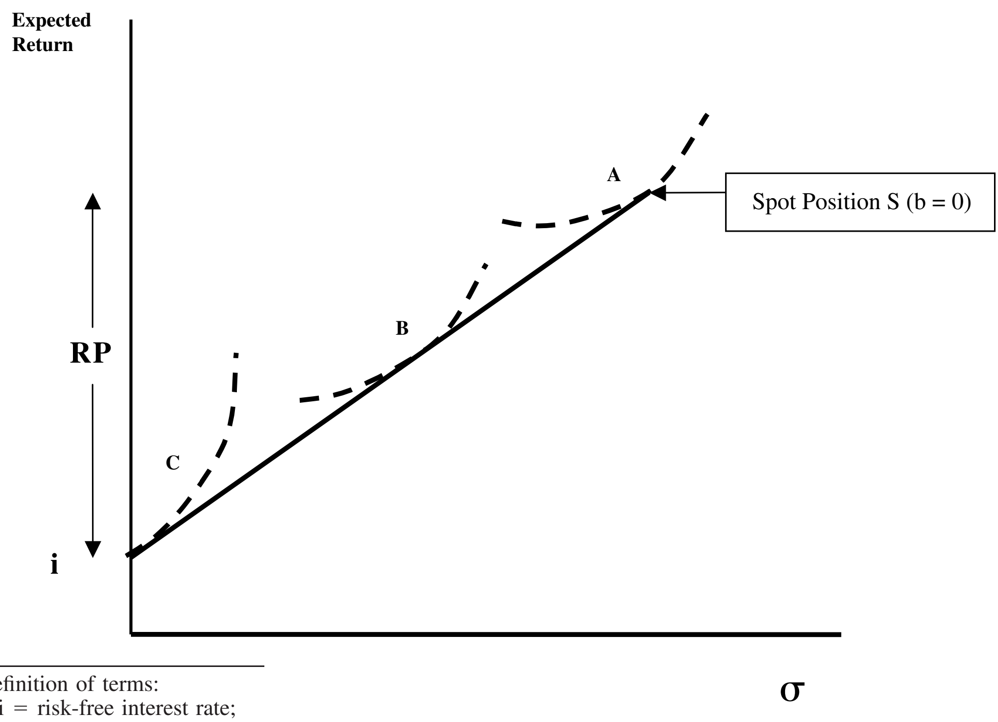
[4] This is equivalent to the requirement that the R^2 in the regression approach be greater than .81, so in essence measures 2 and 3 are different manifestations of the same criterion. To understand the risk reduction of 56 percent, recall that using a hedge ratio of .9 when the correlation between the spot and the futures price is .9 would produce an expected R^2 of 81 percent if the futures price changes are regressed on the spot price changes. This means 19 percent of the variance in the spot price is unexplained. But we use standard deviations rather than variance; the unexplained standard deviation is the square root of 19 percent, or 44 percent. So the portion of the spot variance that is avoided through hedging is 1 minus 44 percent, or 56 percent.

The remainder of this paper is organized as follows. The next section presents the cost-effective model as an alternative to the traditional offset and risk minimum hedge ratios. In the third section, we present data from five earlier studies confirming the existence of positive risk premiums for a wide range of futures contracts over the last 50 years. Then we discuss the requirements of SFAS No. 133, IAS No. 39, and subsequent literature describing how to measure hedge effectiveness in practice. The focus of our paper is not on the accounting standards per se, but on the subsequent literature that emphasizes risk minimization. The issues surrounding the implementation of the model are addressed in the fifth section. Our conclusions and recommendations are presented in the final section.

THE COST-EFFECTIVE HEDGE MODEL

Figure 1 captures the risk-return trade-off facing the hedger where a perfect hedging instrument exists. If the hedger held only risk-free securities, then the company would earn i (the risk-free rate of return). However, we assume the company holds a long spot position in the item of interest. The spot position S in Figure 1 is a fixed requirement of the business (e.g., copper inventory held by an electrical wire manufacturer) and so the hedger views the size of this position as fixed. We assume the typical situation of a short hedger in which

FIGURE 1
The Risk, Return Situation Faced by a Hedger When a Perfect Hedging Instrument Exists



Definition of terms:
i = risk-free interest rate;
σ = standard deviation of return;
RP = derivative risk premium; and
b = hedge ratio.

a long spot position is held and an offsetting short derivative is taken.[5] If a short spot position, rather than a long position, is being hedged, then a positive derivative risk premium leads to a hedge ratio larger than the risk minimum since, by taking a long position in the derivative, risk is being reduced while expected return is being increased. This is referred to as a long hedge and will not be discussed in this paper.

The long spot position represented by point S in Figure 1 is characterized by an expected return that is the sum of the risk-free rate i and the risk premium (RP) associated with the risk of holding that position. For example, if i is equal to 4 percent and RP is equal to 6 percent, then the expected spot return is 10 percent. The risk associated with position S is measured as the standard deviation of return (σ), shown on the horizontal axis.

Depending on the company's risk preferences, management may prefer to give up some expected return in order to reduce risk. The spot market RP imparts an expected cost to the derivative.[6] The hedger begins with the unhedged position S (hedge ratio $b = 0$). If a derivative exists that perfectly offsets the spot price risk, then the choices fall on the line between i and S. Company A in Figure 1 does not hedge at all since their risk, return indifference curve, represented by the dashed line, is fairly flat implying the company is very risk tolerant. Company B, on the other hand, is more risk-averse, as shown by the steeper indifference curve, and they hedge a portion of the spot position. Company B reduces both risk and expected return, the latter because the short derivative's RP reduces the company's expected return. Finally, company C is the most risk-averse and decides to fully hedge the spot position (hedge ratio $b = 1$) and ends up earning the risk-free return i.

In most cases, however, the derivative is not perfectly correlated with the spot position. As the hedger shorts the derivative, the risk-return choices fall on the downward curved line in Figure 2. This line lies to the right of the i-S line because the derivative is an imperfect hedging instrument and reduces less risk than the (unattainable) perfect hedge. The curve is shaped like a parabola because the risk due to the imperfect hedge is reduced at a decreasing rate as the hedge ratio increases.

If the hedger takes a full offset position ($b = 1$), then the resulting hedged position falls on the dashed portion of the curve in Figure 2. This position has the undesirable characteristics of having an expected return equal to i and a risk that is generally greater than could be obtained with a smaller hedge ratio. On the basis of risk and return, fully offsetting the spot position is not optimal.

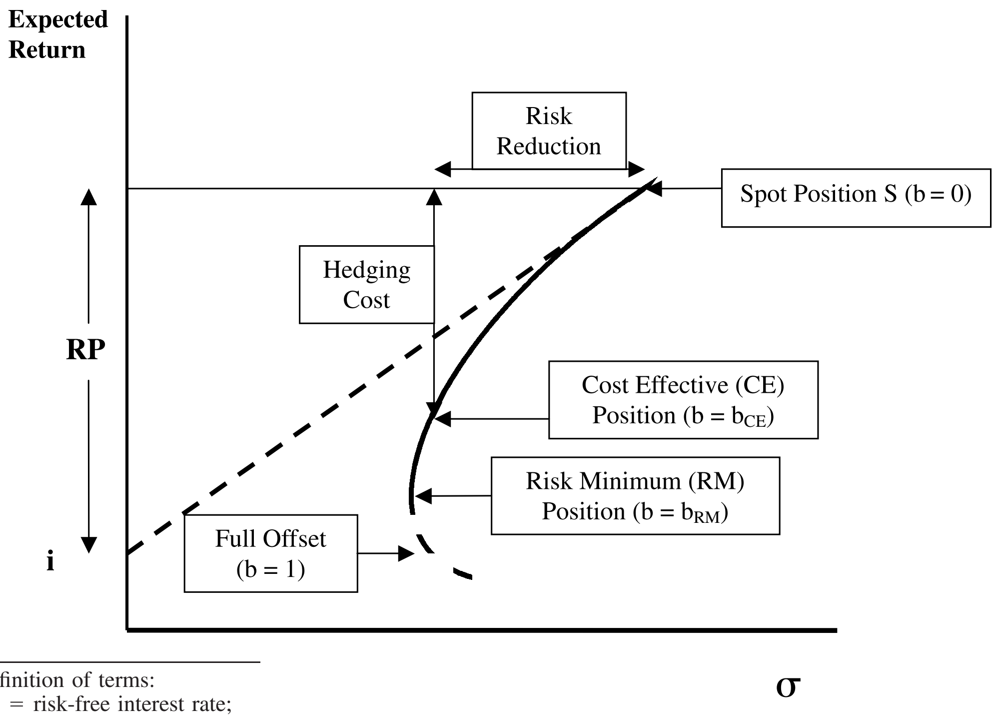
If the hedger backs off and instead takes the hedge ratio that minimizes risk ($b = b_{RM}$), then the resulting hedged position falls on the furthest to the left point on the curve in Figure 2. This point produces the lowest risk possible with this imperfect hedging instrument, but it also has a very low expected return since by shorting the derivative, the resulting expected return is driven toward i. This position is close to the one that might be taken by the highly risk-averse company C represented in Figure 1.

The slope of the curve in Figure 2 is vertical at $b = b_{RM}$, which means that the marginal cost of obtaining the next unit of risk reduction is infinite. Unless the hedger is completely

[5] We will focus on forward and futures hedges in this paper. Application of our recommendations to options and more exotic hedges, while possible, requires explanations beyond the scope of the current paper.

[6] Siegel and Siegel (1990) demonstrate that the spot market RP is passed onto the corresponding derivative via arbitrage. Since most derivatives require little or no upfront money, the expected return on such instruments is comprised entirely of a risk premium. In addition, the lack of an initial investment requires the usual definition of return to be replaced by contract value changes so that a risk premium is the annual expected percent change in the derivative's contract value.

FIGURE 2
The Risk, Return Situation Faced by a Hedger When a Perfect Hedging Instrument Does Not Exist



Definition of terms:
i = risk-free interest rate;
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RP = derivative risk premium; and
b = hedge ratio.

risk-averse, this point on the curve is suboptimal. A hedge ratio of less than b_{RM} is preferred. We call this the "cost-effective" hedge ratio ($b = b_{CE}$). This could be the position taken by the somewhat risk-averse company B represented in Figure 1.

The hedging cost shown in Figure 2 is comprised of two components: (1) the reduction in expected return resulting from the short position in the derivative, represented by the distance between the horizontal line emanating from S and the dashed i-S line in Figure 2 (the result of shorting the derivative with a positive RP) and (2) the additional cost resulting from the lack of perfect correlation, represented by the distance between the dashed i-S line and the downward curved portfolio line.[7]

In accounting terms, the resulting hedge expected return impacts expected earnings, while the amount of risk reduction determines the company's risk. As the hedger moves up along the curved line in Figure 2 from RM to CE, an explicit trade-off between increased risk and increased expected earnings is being made. CE is the point beyond which this trade-off no longer appeals to the hedger. The additional risk incurred by moving from position RM up to CE comes with the benefit of increased expected earnings. The steepness

[7] See Howard and D'Antonio (1994) for further details and the mathematical proofs underlying Figure 2.

of this line segment indicates substantial earnings increases are accompanied by small risk increases, which means the company is improving its expected earnings by moving to CE from RM.

To help illustrate theses points, consider the following example of holding a 100-unit long spot position over a one-year time period. Suppose three equally possible price outcomes can occur at the end of year 1:

Time	Spot Prices	Spot Profit (loss)	Return
0	2.00		
1	2.50	\$50.00	25%
	2.20	\$20.00	10%
	1.90	(\$10.00)	−5%

The hedger faces price risk and, in turn, faces uncertainty with respect to the return earned for the year. The expected return is 10 percent and spot σ is 15 percent.[8] If we assume a risk-free rate i = 4 percent, then the spot RP is 6 percent (i.e., 10% – 4%). If the futures contract is a perfect substitute for the spot transaction, then the futures price will be equal to current spot price times 1 + i, or \$2.08. Assume the hedger takes on the full offset position (assuming the spot and futures σ are the same) of 100 units. The hedged price (i.e., period-ending spot transaction net of futures closeout gain or loss) at the end of the year will be \$2.08, since the hedger can deliver the spot against the futures contract and receive the agreed upon price of \$2.08. Thus, the return for the year will be the risk-free 4 percent. In Figure 1, this is tantamount to moving down the i-S line to point i.

Now assume a futures contract that is not a perfect substitute for the spot transaction, such as not having the same delivery date, location, quality, quantity, or even a different delivery item all together (e.g., using copper futures to hedge a copper wire position). The futures price at the beginning of the year is equal to the full carry price of \$2.08, since spot futures arbitrage is still possible. Assume again that the hedger takes the fully offsetting hedge of 100 units of the futures, but uncertainty remains about the final hedged price as follows:

Time	Hedged Prices	Hedged Profit (Loss)	Return
0	2.00		
1	2.28	\$28.00	14%
	2.08	\$8.00	4%
	1.88	(\$12.00)	−6%

Note that the expected return is now 4 percent, which is the risk-free rate, while the hedged σ is 10 percent. This is unattractive since the hedger is earning the risk-free rate but is still exposed to considerable risk. This is the point b = 1 in Figure 2, which falls on the dashed portion of the curve.

Now assume that the hedger takes on the risk minimum hedge ratio b_{RM}, which means shorting 90 futures units, and the resulting hedged prices and returns are:

[8] Since the high and low deviate from the mean by 15 percent, it follows that the standard deviation is also 15 percent ($\sigma = \sqrt{(15\%^2 + 15\%^2)/2}$).

Time	Hedged Prices	Hedged Profit (Loss)	Return
0	2.00		
1	2.26	\$26.00	13%
	2.10	\$10.00	5%
	1.98	(\$6.00)	−3%

The expected return is now 5 percent and the hedged σ is 8 percent, superior to the full offset result. This is the same as moving up the curved line in Figure 2 from $b = 1$ to $b = b_{RM}$.

But if the results improved by moving from $b = 1$ to $b = b_{RM}$, then why not continue moving up the curve? This is the idea behind the cost-effective model and b_{CE}. Assume that the hedger now takes on b_{CE}, which means shorting 65 futures units, with the following results:

Time	Hedged Prices	Hedged Profit (Loss)	Return
0	2.00		
1	2.32	\$32.00	16%
	2.14	\$14.00	7%
	1.96	(\$4.00)	−2%

The expected hedged return is now 7 percent and the hedged σ is 9 percent. In Figure 2, this is represented by moving from $b = b_{RM}$ to $b = b_{CE}$. This is the point beyond which the hedger has determined the gain in expected return is not worth the additional risk taken on.

As is shown in Howard and D'Antonio (1994), the cost-effective hedge ratio (b_{CE}) is a function of the risk minimum hedge ratio (b_{RM} from Ederington 1979) as follows:[9]

$$b_{CE} = b_{RM}\,[1 - (A/\rho\pi)\sqrt{(1 - \rho^2)/(1 - A^2/\pi^2)}] \tag{1}$$

where:

$$A = RP/(RP + mc_u), \tag{2}$$

$$\pi = \sigma_d/\sigma_s, \tag{3}$$

where σ_d and σ_s are the standard deviation of the derivative and spot, respectively

$$b_{RM} = \rho/\pi, \tag{4}$$

where:

ρ = the correlation between spot, derivative correlation; and
mc_u = the upper marginal hedging cost that is acceptable to the hedger.

[9] See Chen et al. (2003) for a comprehensive review of the hedge ratio literature.

For any given hedge ratio, b, risk reduction (RR) as a fraction of the spot standard deviation σ_s is given by:

$$RR = 1 - \sqrt{1 + b^2\pi^2 - 2b\rho\pi} \tag{5}$$

and hedging cost (HC) is given by:

$$HC = bRP. \tag{6}$$

The RR Equation (5) measures the horizontal distance, as a fraction, from the spot position S to the position characterized by the hedge ratio b on the portfolio curve. RR reaches a maximum when $b = b_{RM}$. In Figure 2, HC is the vertical distance from S to the curve and the coordinates (b, HC, RR) define all points on the curve. Thus, the decision facing the hedger is to choose b so that the desired level of RR and HC are achieved.

Equations (1) through (6) simply depict how a hedge ratio that does not eliminate all risk may be advantageous to the hedger. This hedge ratio takes into account not only risk, but also the additional amount of expected return that the hedger must give up to obtain the next unit of risk reduction. These six equations are used in the next section to demonstrate how the hedge can be established taking both risk and expected return into account. The cost-effective model does not restrict the hedger's ability to choose but rather enhances it since a highly risk-averse hedger can choose the minimum risk position.

DERIVATIVE RISK PREMIUM

From the foregoing discussion, the existence of a positive RP plays a central role in determining the size of the hedge ratio. An extensive body of research explores whether a nonzero RP exists for derivatives in the futures markets. Keynes (1930) launched this inquiry by coining the term "normal backwardation." Keynes (1930) hypothesized that those holding spot positions were generally long and, thus, entered the futures markets demanding an offsetting short position. In order to entice sufficient short positions, the futures price would have to be a downward-biased forecast of the future spot price and would thus provide a RP to those taking a long futures position. Keynes (1930) thought this was normal in futures markets and dubbed this situation "normal backwardation." The opposite situation (i.e., a negative RP) is referred to as "contango." Others followed with additional hypotheses such as Working's (1948) theory of storage and the convenience yield. Dusak (1973) tested whether RP in the futures market could be explained within a CAPM framework. Since then a series of articles have explored whether RP can be explained within the context of various equilibrium pricing models.

All of these inquiries boil down to a single question: Are futures' RPs positive? The numerous studies addressing this question have come to a variety of conclusions, some finding significantly positive RP and others not. In order to examine this question from a practical standpoint, we limit our analysis to the average RP reported in five studies:[10]

[10] We considered results from 23 other studies for possible inclusion in our sample. We did not use these because either they did not add to the coverage provided by the five studies selected and/or did not report the necessary information (risk premiums and sample periods). Overlapping studies do not help in assessing RP. This is different from the more typical case in which statistical results from various studies are gathered together (e.g., meta analysis) and overlapping samples may be useful in that different statistical results were obtained in different studies.

Bodie and Rosanksy (1980), Fama and French (1987), Kolb (1992),[11] Miffere (2000), and de Roon et al. (2000). We picked these studies because (1) each covers a large number and variety of futures contracts over an extended time period and (2) each reports average contract RP and the corresponding sample period. This latter feature allows us to focus on the question at hand (are futures' RPs positive) without having to reconcile the different questions and methodologies used in each study.

Combining the results for the five studies, we compute annual RP for 37 different contracts divided into nine groups (energy, interest rates, currency, grains, mining, other crops, livestock, forest products, and stock indices) spanning 47 years from 1950 to 1996. The annual contract arithmetic[12] RP for each of the 37 contracts are reported in Table 1.[13] (The groups and the contracts within groups are arranged in ascending RP order for ease of exposition later in the paper.) In order to calculate the best estimate for each futures contract, the RP over the different studies were averaged and, when samples overlapped, the shorter period was eliminated. Even so, some overlap remains in the reported RP in Table 1. In addition, the sample period and number of years (partial years are included) for each contract are reported. The RP ranges from a low of –142bp for the crude oil contract to a high of 1,392bp for the S&P 500 contract. Only two of the contracts have a negative RP (crude oil and heating oil) with both being close to 0. The overall average RP is 601bp with the average sample period being 25.8 years (from a low of 9 years to a high of 47 years). Overall, the results in Table 1 provide evidence that hedgers often face a positive RP and in turn a cost to hedging.

To help visualize RP variation across contract groups, the range as well as the group average for the nine contract groups are graphed in Figure 3. Keep in mind that the groups are arranged in ascending average RP's and there is no economic significance to this ordering.

The results in this section provide an argument that positive RP are common in futures markets. In addition, nonzero RP will likely be passed onto other derivatives by means of inter-market arbitrage. If so, then the typical hedger who takes a short position in a derivative will often incur a cost in the form of reduced expected earnings. This cost is important when making the hedge decision.

THE HIGHLY EFFECTIVE HEDGING REQUIREMENT

In order to qualify for hedge accounting, a company must satisfy several requirements, among them demonstrating the hedge is "highly effective" both before the fact (prospectively) and after the fact (retrospectively). SFAS No. 133 and IAS No. 39 do not provide a brightline test of what is meant by "highly effective" and thus the hedger selects the method for measuring hedge effectiveness and the critical limits for this measure.

> This Statement requires that an entity define at the time it designates a hedging relationship the method it will use to assess the hedge's effectiveness in achieving offsetting changes in fair value or

[11] Kolb (1996) reports on a large number of contracts (49) but over a shorter 24-year sample period (1969–1992) with some of the contracts having less than 10 years of data. We chose his earlier 1992 article because it covered a longer 30-year time period (1959–1988), it largely overlapped the later study, and it reported the actual sample period for each contract which the later study did not.

[12] In some cases, prior papers report geometric values, but since hedging decisions generally involve shorter time periods, average rather geometric risk premiums are more relevant.

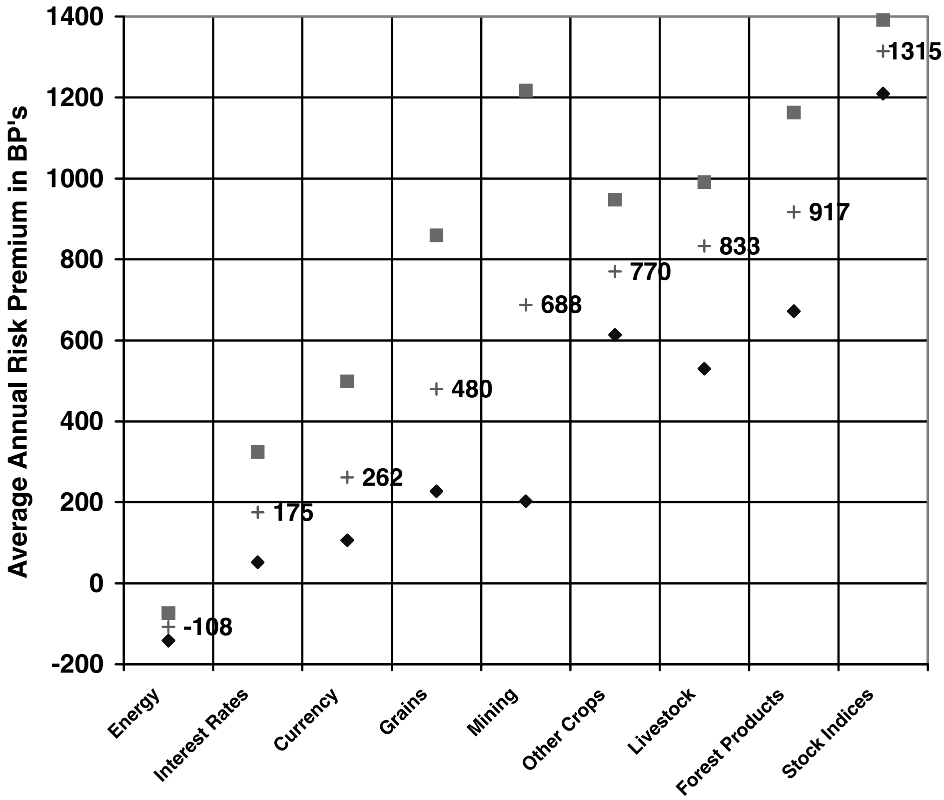
[13] Reported results are based on the near contract with the exception of Kolb (1992) who reports daily risk premiums on all delivery months over the entire time each contract was traded. We eliminated four contracts from consideration due to their extreme risk premiums: eggs (–14.42 percent), soy oil (17.69 percent), sugar (19.96 percent), and propane (68.25 percent).

TABLE 1
Historical Futures Risk Premiums in Basis Points

Groups/Contracts		Time Span	# Years	Contract Average[a]	Group Average
Energy					
	Crude Oil	1983–1994	12	−142	−108
	Heating Oil	1979–1996	18	−74	
Interest Rates					
	T-Bill	1976–1996	21	52	175
	Eurodollar	1986–1994	19	72	
	T-Bond	1977–1996	20	251	
	T-Note	1982–1996	15	324	
Currency					
	British Pound	1977–1996	20	106	262
	Swiss Franc	1977–1996	20	153	
	Deutsche Mark	1977–1996	20	209	
	Canadian Dollar	1986–1994	9	345	
	Japanese Yen	1977–1996	20	499	
Grains					
	Corn	1950–1996	47	227	476
	Wheat	1950–1996	47	238	
	Oats	1950–1996	47	264	
	Soybeans	1950–1996	47	793	
	Soy Meal	1950–1996	47	860	
Mining					
	Gold	1975–1996	22	203	688
	Platinum	1964–1996	33	261	
	Silver	1963–1996	34	560	
	Copper	1953–1984	32	1200	
	Palladium	1977–1988	12	1217	
Other Crops					
	Cotton	1950–1996	47	614	770
	Coffee	1979–1996	17	663	
	Potatoes	1950–1976	27	691	
	Cocoa	1953–1976, 1982–1996	39	936	
	Orange Juice	1967–1984	18	948	
Livestock					
	Feeder Cattle	1974–1988	15	530	833
	Wool	1950–1976	27	744	
	Live Cattle	1965–1994	30	815	
	Pork Bellies	1963–1996	34	933	
	Broilers	1968–1984	17	984	
	Live Hogs	1969–1996	28	991	
Forest Products					
	Lumber	1970–1996	28	672	917
	Plywood	1970–1984	15	1163	
Stock Indices					
	Value Line	1986–1994	19	1210	1315
	NYSE	1982–1996	15	1344	
	S&P 500	1982–1996	15	1392	
		Average	25.8	601	

[a] The average risk premiums are estimated using the information reported in the five studies listed in the text. Fully overlapping samples were eliminated (e.g., when there was data from both the Miffre [2000] and the de Roon et al. [2000] studies the de Roon et al. data were eliminated since the longer Miffre sample period fully overlapped). A simple average of the remaining sample means was then calculated.

FIGURE 3
Range of Risk Premiums for Various Contract Groups
(□ represent the high, + the average, and ◇ the low values in each contract group)



> offsetting cash flows attributable to the risk being hedged. ... This Statement does not specify a single method for either assessing whether a hedge is expected to be highly effective or measuring hedge ineffectiveness. The appropriateness of a given method of assessing hedge effectiveness can depend on the nature of the risk being hedged and the type of derivative used. (SFAS No. 133, para. 62)
>
> This standard does not specify a single method for assessing hedge effectiveness. (IAS No. 39, para. 151)
>
> The method an enterprise adopts for assessing hedge effectiveness will depend on its risk management strategy. In some cases, an enterprise will adopt different methods for different types of hedges. (IAS No. 39, para. 147)

A number of authors have stepped in to fill the gap between accounting standards and the practical application of these standards. These include Althoff and Finnerty (2001), Cannabaro (1999), Coughlan et al. (2003), Finnerty and Grant (2002), Kalotay and Abreo (2001), Kawaller and Koch (2000), and Royall (2001). These have followed the risk-minimization approach that was first launched by Ederington (1979) in which the correlation between spot and the derivative plays a central role. The higher the correlation, the better the hedge, and the greater the risk reduction. This literature stream is the primary basis for the three recommended hedge effectiveness measures described in section one (dollar offset, regression, and risk minimization).

The shortcoming of these three approaches is that they ignore the cost of hedging, the primary component of which is the RP on the derivative. Most hedgers face long positions (meaning that they own wheat, gold, currency, etc.) and, thus, take a short position in the derivative (referred to as a short hedge). This means that the expected return on the spot position is reduced by the expected loss on the derivative. By ignoring RP, the hedger is over-committing to the derivative and, thus, reducing the overall return below the optimal level.

Even though much of the discussion surrounding SFAS No. 133 and IAS No. 39 is couched in the language of risk reduction, nothing precludes considering both risk and cost when making the hedging decision.

> At inception of the hedge, there is formal documentation of the hedging relationship and the *entity's risk management objective* and strategy for undertaking the hedge, including identification of the derivative, the hedged item, the nature of the risk being hedged, and how the derivative's effectiveness in offsetting the exposure to changes in the hedged item's fair value attributable to the hedged risk will be assessed. (SFAS No. 133, para. 20a)[14] (emphasis added)

Clearly both risk and cost can be considered as long as this is consistent with the ''entity's risk management objective.'' Since both risk and cost are present in changes in the fair value and cash flows of the spot position and derivative, both are measured any time the change in fair value is calculated. SFAS No. 133, para. 63 allows a few factors (i.e., the time value on options contracts, changes in the volatility value of an option contract, and the forward and futures basis) to be excluded from measuring hedge effectiveness. However, the RP for a short hedge cannot be excluded. Thus, by implication, all measures of hedge effectiveness and ineffectiveness will include both risk and cost. Focusing exclusively on risk reduction alone when the spot and derivative fair value changes are influenced by the existence of a RP results in a less than optimal trade-off between risk and cost.

Consider an example that illustrates the impact of a RP on the accounting for both hedge effectiveness and ineffectiveness. Assume a company has a long position in a commodity that it expects to sell in four quarters. To avoid commodity price risk, the company enters into a short futures contract that has some ineffectiveness. The accounting standards reporting requirements are as follows:

- If the change in basis (futures price – spot price) has been excluded from the measure of hedge effectiveness, then the quarter's change in basis is recorded in current earnings.
- The quarter's ineffectiveness is reported in current earnings. (Note: ''excluded from determination of effectiveness'' and ''ineffective'' are not the same thing and are addressed separately in the accounting standards.)
- The profit from selling the asset at spot price in quarter 4 net of the effective portion of the hedge is reported in quarter 4 earnings.[15]

In quarters 1, 2, and 3 the only items that affect earnings for a qualified hedge are exclusions and ineffectiveness. The effective portion of the hedge will affect earnings in quarter 4. As we demonstrated in the second section, the application of the cost-effective model is tantamount to choosing the ''optimal'' level of risk exposure in light of a positive

[14] See also SFAS No. 133, para. 28a.
[15] For a fair value hedge, this takes the form of the selling price net of the adjusted carrying value and for a cash flow hedge, this takes the form of the selling price net of the OCI reversal.

RP. In terms of accounting, the risk-minimization approach leads to a non-optimal level of risk, while the cost-effective model leads to greater risk and greater expected earnings. Consequently, application of the cost-effective model, rather than the risk minimum ratio, leads to the firm choosing to partially hedge the spot position. The portion hedged will be then be subject to hedge accounting requirements.

IMPLEMENTING THE COST-EFFECTIVE MODEL

The results in Table 2 present an application of the cost-effective model. For this example, we assume a correlation between the spot and derivative of .9, the lowest that is currently recommended for meeting the ‘‘highly effective’’ hedge criteria; equal spot and derivative standard deviations (i.e., $\pi = 1$),[16] and RP is equal to 600bp, which is the overall average reported in Table 1. Using Equations (1) though (6), Table 2 presents HC and RR (for the entire spot position) for various hedge ratios from 50 percent to 100 percent of b_{RM}. The final column presents the marginal cost (mc) for obtaining the next unit of risk reduction and is given by:[17]

TABLE 2
Risk Reduction, Hedging Costs, and Marginal Costs for Various Hedge Ratios

Assumptions

ρ	0.9
π	1.00
b_{RM}	0.90
RP	600
mc_u	1100

Outcomes

b/b_{RM}	b	RR	HC(bp)	mc(bp)
50%	0.45	37%	270	840
60%	0.54	43%	324	940
68%	0.62	48%	370	1100
70%	0.63	49%	378	1140
80%	0.72	53%	432	1570
90%	0.81	55%	486	2970
100%	0.90	56%	540	∞

Definition of terms:
RP = derivative risk premium;
ρ = spot, derivative correlation;
b = hedge ratio measured as derivative position as fraction of spot position;
b_{RM} = risk minimum hedge ratio;
RR = risk reduction, 100 percent minus the hedged σ as percent of spot σ;
HC = hedging cost;
mc = marginal cost per unit of risk reduction;
mc_u = marginal cost upper bound; and
bp = basis points measured as 100th of 1 percent.

[16] The model works for other values of ρ and π. Both of these assumptions are close to the situation that many actual hedgers face and so using them for demonstration purposes seems reasonable.
[17] See Howard and D'Antonio (1994) for the derivation of this equation. The value mc is the slope of the curve in Figure 2 evaluated at the given hedge ratio.

$$mc = RP\sigma_b/(\pi^2(b_{RM} - b)), \text{ where} \quad (7)$$

$$\sigma_b = \sqrt{1 + b^2\pi^2 - 2b\rho\pi}. \quad (8)$$

Equation (7) expresses the change in expected return per unit of risk reduction.

The last column in Table 2 shows how rapidly mc increases as the hedge ratio approaches b_{RM}. At a hedge ratio of 70 percent of b_{RM}, mc is nearly twice the value of RP (1140bp versus 600bp). Because of this rapid rise in mc, most hedgers would choose a hedge ratio well below b_{RM} since the improvement in RR is not worth the additional cost. The third row in Table 2 is based on the assumption that the hedger places an upper bound of 1100bp on mc (designated mc_u). In this case the hedge ratio chosen is 68 percent of b_{RM}, risk reduction is 48 percent (compared to 56 percent using b_{RM}) and the hedging cost is 370bp (compared to 540bp using b_{RM}). That is, the hedger has garnered most of the potential risk reduction while reducing HC by 170bp.

The example above assumes that the hedger has a mc_u that is 500bp above the RP of 600bp. While RP can be estimated using historical data, mc_u is a consequence of the hedger's degree of risk aversion. For a particular hedger, mc_u may be infinite (close to company C in Figure 1) in which case the risk minimum hedge ratio b_{RM} will be chosen and the cost of hedging will not be taken into consideration when making the hedging decision. In most situations, we expect the hedger will want to consider both risk and cost (company B in Figure 1) and thus will have an implicit assumption regarding mc_u.

Application of the cost-effective model requires estimating ρ and π, as does the risk minimum approach. The cost-effective model also requires estimating RP and specifying mc_u. The RP estimates we present in Table 1 are, in most cases, based on long sample periods and represent a good starting point. Our model would also allow the hedger to input their expected premium if it differs from historical data. Our approach therefore provides maximum flexibility to the hedger. If the RP is believed to be zero, then our model collapses to the risk-minimization approach. However, if the hedger anticipates a RP exists, then our model accounts for the RP and adjusts the hedge ratio accordingly.

The mc_u estimate does not depend upon gathering data but instead depends upon the generally unobservable risk preferences of the hedger. One way to set this value is to have the hedger examine the RR and HC results such as those presented in Table 2. By examining both risk and cost, the hedger should be able to identify when to stop increasing the short hedging position. The corresponding hedge ratio becomes b_{CE} and the resulting marginal cost is mc_u.

Once estimates for ρ, π, RP, and mc_u are obtained, the hedger is ready to use the cost-effective model. In order to demonstrate this application, we use the RP estimates from Table 1 and apply the model to each of the 37 contracts. We make the plausible assumptions that $\rho = .9$, $\pi = 1$, and $mc_u = RP + 500bp$. This last assumption implies that the hedger is more risk-averse than is the average participant in the underlying spot market, which seems reasonable since the primary goal of hedging is to reduce risk (company B in Figure 1). If, on the other hand, we assume that mc_u equals RP, then the company will not hedge at all and will thus hold the unhedged spot position S (company A in Figure 1).

The hedging decision results are reported in Table 3. Beyond the results for each of the 37 contracts, the nine group averages are also reported. Focusing on the five contracts within the mining group, we see that the average RP is 688bp, the average hedge ratio is 68 percent of the risk minimum hedge ratio ($b_{RM} = .9$ is this example), the average risk reduction is 47 percent, and the average hedging cost is 364bp. On average, then, the model allows hedgers in the mining industry to garner a large percentage of potential risk reduction

TABLE 3
Hedging Decisions Based on Cost-Effective Model
assuming $\rho = .9$ and $\pi = 1$ ($b_{RM} = .9$ and max RR = 56%) and mc_u = RP + 500bp

Contract		RP(bp)	mc_u	b_{CE}/b_{RM}	RR	HC(bp)
Petroleum (average)		−108	—	100%	56%	—
	Crude Oil	−142	—	100%	56%	—
	Heating Oil	−74	—	100%	56%	—
Interest Rates(average)		175	675	88%	55%	131
	T–Bill	52	552	95%	56%	45
	Eurodollar	72	572	94%	56%	61
	T–Bond	251	751	83%	54%	187
	T–Note	324	824	79%	53%	231
Currency (average)		262	762	83%	53%	187
	British Pound	106	606	91%	56%	87
	Swiss Franc	153	653	88%	55%	122
	Deutsche Mark	209	709	85%	54%	160
	Canadian Dollar	345	845	78%	52%	243
	Japanese Yen	499	999	72%	50%	323
Grains (average)		476	976	75%	50%	292
	Corn	227	727	84%	54%	172
	Wheat	238	738	83%	54%	179
	Oats	264	764	82%	54%	195
	Soybeans	793	1293	62%	45%	445
	Soy Meal	860	1360	60%	44%	468
Mining (average)		688	1188	68%	47%	364
	Gold	203	703	85%	54%	156
	Platinum	261	761	82%	54%	194
	Silver	560	1060	70%	49%	352
	Copper	1200	1700	52%	38%	559
	Palladium	1217	1717	51%	38%	562
Other Crops (average)		770	1270	63%	45%	433
	Cotton	614	1114	68%	48%	376
	Coffee	663	1163	66%	47%	396
	Potatoes	691	1191	66%	46%	407
	Cocoa	936	1436	58%	43%	492
	Orange Juice	948	1448	58%	42%	495
Livestock (average)		833	1333	62%	44%	454
	Feeder Cattle	530	1030	71%	49%	338
	Wool	744	1244	64%	46%	428
	Live Cattle	815	1315	62%	44%	453
	Pork Bellies	933	1433	58%	43%	491
	Broilers	984	1484	57%	42%	506
	Live Hogs	991	1491	57%	42%	508
Forest Products (average)		917	1417	59%	43%	475
	Lumber	672	1172	66%	47%	400
	Plywood	1163	1663	53%	39%	551
Stock Indices (average)		1315	1815	49%	37%	580
	Value Line	1210	1710	51%	38%	561
	NYSE	1344	1844	48%	36%	586
	S&P 500	1392	1892	47%	36%	594

(*continued on next page*)

TABLE 3 (Continued)

Definition of terms:
RP = derivative risk premium;
ρ = spot, derivative correlation;
π = ratio of derivative σ to spot σ;
b = hedge ratio measured as derivative position as fraction of spot position;
b_{RM} = risk minimum hedge ratio;
b_{CE} = cost-effective hedge ratio;
RR = risk reduction, 100 percent minus the hedged σ as percent of spot σ for the full spot position;
HC = hedging cost;
mc = marginal cost per unit of risk reduction;
mc_u = marginal cost upper bound; and
bp = basis points measured as 100th of 1 percent.

by establishing a hedge ratio that is substantially less than b_{RM} at a cost that is about half what it would have been if the hedge ratio were b_{RM}. The mining group has the widest range of results for any group, with gold having the lowest RP within the group and palladium having the highest. Assuming that similar economic forces underlie each contract within a group, the group average may provide a more reliable estimate of RP than any individual contract estimate.

In summary, the steps for implementing the cost-effective hedge are as follow:

1. Estimate the derivative RP. The RP can be estimated and documented using historical futures/forward data or a RP estimate can be obtained from one of the many futures studies, five of which are cited in this paper and summarized in Table 1.
2. Estimate the ratio of derivative to spot standard deviations (π). Most empirical studies find π to be slightly less than 1.
3. Estimate the correlation between the derivative and the spot position (ρ). Note that the same set of historical data can be used in steps 1, 2, and 3.
4. Situations in which the CE approach should *not* be used:
   a. the RP is zero or negative, and
   b. the derivative is a perfect match for the underlying spot position (i.e., perfectly correlated).
5. Determine the hedger's marginal cost upper bound (mc_u). Evidence from other financial markets (e.g., stock market, venture capital, etc.) indicates a rough range for mc_u of 5 percent to 15 percent per unit of risk reduction, with a higher value indicating the company is more risk-averse and thus willing to "pay" a higher price for risk reduction. If the company has decided to hedge, then implicitly the company is saying mc_u exceeds RP. It may make sense to set mc_u as a matter of company policy.
6. Determine the CE hedge ratio (b_{CE}) by inputting the estimated values of RP, π, ρ, and mc_u into Equation (1). This represents the portion of the spot position to be hedged and the portion to which hedge accounting will be applied. Using the example presented earlier in this section, if the value of mc_u is 11.40 percent, then as shown in Table 2, b_{CE} is 0.63, which means the cost effective derivative position is 63 percent of the spot position, and the resulting risk reduction for the entire spot position is 49 percent.
7. In the example in point 6 above, designating 63 futures contracts to cover 100 physical items would not obtain the expected level of offset recommended by previously cited commentators, and thus would not qualify for hedge accounting

using past criteria. However, having a corporate policy that the company plans to hedge 63 percent (in this example, this can be stated more generally as 70 percent of the b_{RM}) of its exposure to market risk for this spot item would jointly satisfy the traditional measures of effectiveness (63 units of derivative should be highly effective in offsetting the risks in 63 units of spot) but at the same time avoid the high cost of overhedging. SFAS No. 133 allows a hedging strategy to incorporate costs, so that using our approach, hedging a 100-unit spot with 63 units of derivative should satisfy the prospective high effectiveness test. Note that the 63 percent hedge ratio depends on mc_u, which is company-specific. There could be many companies, all stating they are hedging 100 percent of their spot exposure under our approach, but depending on their mc_u, their hedge ratios could vary dramatically. But by requiring the companies to explicitly state the percentage of exposure being hedged, the financial statement reader can identify differences in the companies' hedging activities. Thus, the most practical approach appears to be using our model to select b_{CE}, and then stating a policy of hedging b_{CE} percent of the company's exposure while applying more traditional tests for prospective effectiveness.

8. The company will have to satisfy the other requirements of SFAS No. 133 in order to apply hedge accounting to the hedged portion of the spot position.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this paper is to provide a cost-effective method for determining the proportion of a spot position to be hedged. We demonstrate that hedgers who face a positive derivative risk premium and focus on risk-minimization measures will generally over-hedge. Using the cost-effective model involves trading off increased risk with lower costs. We show that accepting an increase in risk can produce superior risk return results for the company. That is, a small increase in risk is offset by a large cost reduction.

Using futures return data from five previous studies over the 47-year period 1950 to 1996, we estimate the average derivative risk premium to be 601bp. Using the cost-effective model along with the risk premium estimates for 37 contracts, we demonstrate that the hedge ratio chosen is significantly less than the risk minimum hedge ratio since the marginal cost of hedging rises dramatically as the minimum risk position is approached.

In order to implement the cost-effective model, estimates for the spot, derivative correlation, and the ratio of derivative volatility to spot volatility are needed. We note that these are also required when the traditional risk-minimization approach is used. In addition, implementing the cost-effective model requires estimates of the risk premium for the derivative and the maximum marginal cost the hedger is willing to accept. We demonstrate that the larger is the risk premium, the more important it is to employ to the cost-effective model. As this is done, companies will make better hedging decisions than those resulting from the application of the risk minimum approach.

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